Foreign direct investment and technology spillovers in low and middle-income countries : a comparative cross-sectoral analysis

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Foreign Direct Investment and Technology Spillovers in Low and Middle-income Countries: A Comparative Cross-sectoral Analysis[†]

A Background Paper for the UNIDO Industrial Development Report

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Abstract

In this paper we analyse the trends in Foreign Direct Investment (FDI) flows worldwide across sectors and across value-chain activities, with a particular focus on low- and middle-income countries in comparison with advanced countries. We begin by discussing the growing fragmentation of global production and the opportunities this presents to today's developing countries for benefiting from FDI. Our review of the literature on knowledge spillovers via FDI indicates that spillovers typically occur along the value chain, from foreign firms to their local suppliers or clients but not to their competitors, and that tapping into the technological resources of foreign firms is not an automatic process but hinges on a few host-economy characteristics. Our analysis of worldwide FDI flows during 2008-2013 indicates the growing importance of countries outside the traditional industrialised world, accounting for nearly half of inward greenfield FDI projects. While FDI flows into industrialised economies and emerging industrial economies take place mainly in high- or medium-tech manufacturing, other developing countries and least developed countries tend to attract FDI in medium- and low-tech manufacturing. When we examine FDI flows across value-chain activities, we find that emerging economies are attracting increasingly more knowledge-based FDI, with China and India hosting the highest number of FDI projects in innovation activities. Finally, our analysis suggests that – especially in the manufacturing sector – Multinational Enterprises (MNEs) tend to invest more in countries where domestic technological efforts are higher, pointing to the importance of indigenous technological capacities in attracting FDI in the first place, but also in ensuring that these investments generate knowledge spillovers that are crucial for technological catching up by developing countries.

JEL Codes: F21; O11; O33.

Keywords: Foreign Direct Investment, FDI Spillovers, Indigenous Capabilities, Global Value Chain, Catch Up, Emerging Economies.

Foreign Direct Investment and Technology Spillovers in Low and Middle-income Countries: A Comparative Cross-sectoral Analysis

1. Introduction

Recent decades have witnessed an astonishing increase in the process of economic globalisation: national economies are increasingly integrated with each other through progressively open policies in the realms of trade and investment. Until the late 1980s Foreign Direct Investment (FDI) flows to developing countries were driven primarily by the need to circumvent high tariff barriers for accessing host country markets. Today, however, economic liberalisation over the last quarter century in many parts of Asia, Africa and Latin America, and the fall of the 'Iron Curtain' in Eastern Europe, has allowed Multinational Enterprises (MNEs) not only easier access to these markets but also, given the growing competition in the increasingly globalised market place, greater flexibility to tap into globally dispersed resources and competences.

FDI in recent decades has grown at double the speed of world trade which, in turn, has accelerated at double the speed of world income (Iammarino and McCann, 2013). Between 1995 and 2013, global FDI inflows increased more than fourfold from US$ 324 billion to US$ 1.45 trillion (UNCTAD, 2014). FDI stocks have grown in all the regions of the world, especially since the early 2000s, but with significant cross-regional variations (Smeets, 2008). Whereas in the past developed countries were the undisputed beneficiaries of FDI from MNEs, middle-income countries have progressively become more important and today enjoy a sizable share of global FDI. No country exemplifies this trend better than China, which since the mid-1990s has been the second largest recipient of global FDI after the US (UNCTAD, 2014). Our analysis shows that of the close to 120,000 FDI projects reported in the Financial Times *fDi Markets* database, approximately 46% were implemented in developing countries. A vast majority (nearly 80%) of these projects were carried out in Emerging Industrial Economies (EIEs), such as China, Chile, and so forth.

From the point of view of economic development, the growing importance and influence of MNEs in the world economy has prompted considerable debate and research in recent years regarding the prospect

of developing countries acquiring modern technologies via their interactions with MNEs. This debate assumes significance in light of the fact that a number of them, especially among Emerging Industrial Economies (EIEs) and Other Developing Economies (ODEs), have taken – together with a growth in FDI – giant strides in their scientific and technological performances, along with an associated increase in industrialisation and economic growth. Industrialisation is emphasised as the key to rapid economic growth by the structuralist (e.g. Kaldor 1960) and evolutionary (Perez and Soete 1988) traditions to which the authors of the current Industrial Development Report are sympathetic (Cantore et al., 2014). Manufacturing, from a Kaldorian perspective, is the critical engine that drives economic growth by providing vast opportunities for technological learning, economies of scale, and economies of scope, but also by establishing strong linkages with other sectors. The evolutionary tradition goes a step further and highlights the importance of taking advantage of emerging technological systems that can generate improvements over a range of technologies in multiple manufacturing industries such as to create economy-wide technological externalities that can continue for several years, if not decades. A critical question in this regard is, can MNEs act as an engine for the growth of manufacturing sector in developing countries? Our data reveal that manufacturing, together with mining and construction, is the sector in which majority of the FDI projects is occurring. Manufacturing on its own is the single largest recipient of FDI in EIEs, while in ODEs and Least Developed Countries (LDCs), a significant proportion of FDI projects (about 14% and 20% respectively) are in the resource-intensive mining & construction sector.

However, does the involvement of MNEs in host country industries represent the 'manna from heaven' that brings new technologies and competences that can accelerate the growth in productivity and living standards of these economies? Our review of a large and growing body of research, most of which focuses on manufacturing, into the contribution of FDI for technological upgrading and productivity growth reveals that such a relationship is not straightforward, but rather it appears linked to a set of moderating factors which differ across sectors and countries. Diffusion of knowledge to local companies from MNCs is neither automatic nor costless, and MNE affiliates themselves differ in their knowledge creation potential in the host country (Marin and Bell, 2006, 2010). There is a consensus in the literature that a certain level of absorptive capacity in the receiving entities is a crucial precondition for knowledge creation in the affiliates and for technology diffusion to domestic companies (Fu et al., 2011; Crespo and Fontoura, 2007). Furthermore, the literature identifies other factors that shape the extent of knowledge transmission such as the technology gap between foreign and domestic firms (e.g. Girma and Gorg,

2007; Fu and Zhang, 2011), the level of competition in the host country or sector (e.g. Blomström, Goberman and Kokko, 2001), the national intellectual property right regime (e.g. Allred and Park, 2007), and the spatial proximity between foreign and local entities (e.g. Mariotti et al., 2014; Audretsch and Feldman, 1996).

To the best of our knowledge, studies have not explored FDI's presence across sectors, and, in particular, across specific activities that can influence whether FDI contributes more or less to the technological upgrading of low- and middle-income countries. This is a particularly relevant aspect that needs serious scholarly attention given the increasingly fragmented and globally dispersed nature of production. In this paper we will attempt to fill this gap in the existing literature. We focus in particular on the distribution of FDI and of R&D investments across sectors in low- and middle-income countries in comparison with advanced countries. Furthermore, for a limited number of countries, we test if such a distribution is associated with domestic R&D efforts. This comparison is aimed at revealing potential technology spillovers that FDI - favoured by an improved domestic absorptive capacity - might generate, and can act as a platform to carry out more detailed analysis of the effect of FDI on local economies' capabilities.

The paper is organised as follows. Section 2 discusses the growing fragmentation of production and the implications of Global Value Chains (GVCs) for international technology flows. In Section 3 we explore the main literature on knowledge spillovers and technological upgrading through foreign investments, emphasising the importance of complementary indigenous R&D efforts. In Section 4 we describe the trends in cross-border greenfield investments and R&D expenditures across sectors and major country categories, highlighting the central role that manufacturing appears to play in comparison to other sectors. We conclude our study in section 5.

2. Globalisation of production – from trade in goods to trade in tasks

Recent years have witnessed dramatic changes in the organisation of industrial production as well as in the characteristics of global trade. For much of human history, a good produced in a country was largely made up of parts sourced locally. Today, however, production activities have become increasingly fragmented, with many products derived from parts sourced from all over the world (Ernst & Kim 2002). In fact most of global trade is now in intermediate goods and services and in capital goods (OECD, 2013). A few major unbundling forces have facilitated this global fragmentation of production over the last 25

years: first and foremost, the rapid emergence of information and communication technologies together with major improvements in transportation and freight handling have opened up vast opportunities for leveraging the diversity of specialisations across countries; and secondly liberalisation of trade and investment in hitherto regulated economies meant few legal barriers for companies to tap into the markets and the varied capabilities of these countries (Baldwin, 2011). These two forces have allowed MNEs to break up production processes across the globe and exploit the specific locational advantages of countries and regions. In turn, this has transformed the nature of modern trade, which has indeed increasingly moved from "trade in goods" into "trade in tasks" (Grossman and Hansberg, 2008).

Trade in tasks is not limited to manufacturing activities but covers R&D as well. In spite of the gap in technological and innovative performances between developed countries and emerging economies (e.g. Naudé et al., 2013), the increasing availability of good infrastructure and qualified personnel at significantly low wages makes emerging industrial economies and developing countries attract more and more knowledge-based FDI (Franco et al., 2011). While till a couple of decades ago MNEs were mainly centralising R&D activities in one single location (usually near their headquarters), today MNEs are gradually moving towards several geographically dispersed R&D centres that leverage unique local talents and resources (Schmitz and Strambach, 2009). However, localisation and globalisation are becoming increasingly the two sides of the same coin (Scott and Storper, 2007). This is because globalisation, as Ernst & Kim (2002) put, is following a pattern of "concentrated dispersion": mundane, low technology, highly standardised activities are increasingly globalised, while creative, high technology activities are concentrated and rooted in the technological capabilities of a few locations (Ernst & Kim, 2002; Leamer, 2007). Especially within the R&D sector, the "slicing of the global value chain" is getting thinner and thinner and the geographical concentration or dispersion of activities is linked to the degree of their technological complexity. Von Zedtwitz and Gassmann (2002) found that Research—defined as the process to discover new scientific knowledge which has potentials to be used to develop commercially viable products or manufacturing processes—is concentrated in just five regions worldwide, whereas Development—that is the process of creating new products or processes that have commercial values—is substantially more globally dispersed. Thus, while transport and data transmission costs have been decreasing over time, the cost associated with the exchange of complex knowledge is not falling (McCann, 2008). In other words, the global fragmentation of production has

increased the significance of indigenous technological capacities for attracting knowledge-intensive activities and for generating knowledge spillovers from those activities (Fu et al., 2011).

The integration into GVCs represents an important opportunity for developing countries: being part of a GVC allows them to have access not only to a bigger market for their products, but also to external knowledge and technology (Pietrobelli and Rabellotti, 2011). As the above discussion underlines, not every country or region plays the same role or carries the same weight in GVCs; the dynamic relation between countries and their participation in GVCs is highly dependent on their capacity to develop distinctive competitive advantages.

Against the background described above of the growing presence of MNEs in developing countries the following section reviews the literature that has looked into the potential knowledge flows generated by MNEs in developing countries, the types of knowledge flows, and the critical factors that facilitate the flow of knowledge.

3. Technological upgrading via FDI

In this section we provide an overview of the literature on knowledge spillovers with a specific focus on FDI-induced spillovers. We first list the mechanisms through which MNE activities generate spillovers, then assess the available evidence on the presence of spillovers, and finally highlight certain key host-country specific factors that ensure the effectiveness of knowledge spillovers via FDI.

3.1. Knowledge diffusion mechanisms with a focus on FDI

In the process of industrialisation, which has been the primary engine of economic growth since the first Industrial Revolution, technology's role remains undisputed (Szirmai, 2012). In this respect, studies have for long looked into the opportunities for technological catching up of less developed countries through the acquisition of technologies already developed in advanced countries (e.g. Gerschenkron, 1962). With the increasing availability of firm level data, recent years have witnessed a mushrooming of studies that have sought evidence for international technology flows taking place through a variety of channels (for a review, see Jacob and Szirmai, 2007). Cross-country knowledge diffusion channels analysed by the literature have included movement of goods through international trade, movement of skilled personnel, international research collaborations, integration into the emerging global production chains, and through the channel analysed in this paper—FDI. As Fu et al. (2011) note, FDI " … as a bundle of

technological, managerial knowledge, and financial capital has been regarded as a major vehicle for the transfer of advanced foreign technology to developing countries for a long time" (p 1206).

Conceptually, it is important to distinguish between different types of knowledge flows emanating from FDI, such as the direct, intentional *knowledge transfer* from foreign firms to local firms, and the involuntarily knowledge flows, or *knowledge spillovers* that represent an externality. Although the empirical research typically claims to examine knowledge spillovers, some of them are arguably exploring knowledge transfer or a mix of transfer and spillovers of knowledge. While it is hard to definitively pinpoint the exact types of knowledge flows, identifying specific channels of knowledge flows can provide useful insights on the underlying type of knowledge flows.

From the plethora of contributions in the FDI literature, we can identify a number of channels and mechanisms through which knowledge may spill over from MNEs to local firms (Smeets, 2008; Blomström and Kokko, 1998). The first and most significant channel is the relationships that foreign affiliates of MNEs have with their suppliers and clients in host countries (*backward and forward linkages*). On the one hand, MNEs may deliberately decide to transfer knowledge to their suppliers to increase production efficiency along the value chain and to ensure that certain quality standards are met. On the other hand, the semi-public nature of knowledge makes it possible that MNEs unintentionally transfer their knowledge and best practices to their local partners because constant interactions between the two sets of firms can facilitate the close observation and imitation of former's technological capabilities and managerial practices by the latter (*vertical knowledge flows*). Some authors have argued that vertical knowledge flows are essentially knowledge transfers and are unlikely to involve knowledge spillovers (Smeets 2008).

Secondly, knowledge can *spill over* from foreign enterprises to local firms (competitors) operating in the same sector through the imitation of the MNEs' technologies, for example through the reverse engineering of their products and managerial practices (*horizontal spillovers*). Horizontal knowledge spillovers can also arise through the *mobility of (highly-skilled) workers* from the foreign company to a local firm or when workers of the foreign affiliate start a new firm.[1]

[1] In fact labour turnover is such an important source of knowledge that it has become an established strategy of firms seeking to build new competences to set up design or manufacturing activities in important technological hotspots that host a vast pool of highly skilled personnel.

Finally, as MNEs usually use better technologies and are more innovative (in terms of R&D and patent applications) than domestic firms, they tend to *increase the competition* in the host country. The increased competition may force domestic firms to be more innovative and efficient in order to remain competitive (Blomström and Kokko, 1998; Fu et al., 2011).

Given the potential beneficial effects of FDI outlined above, the past decades have seen a growing interest shown by several developing countries to attract FDI. This has often resulted in a sort of bidding war and fiscal competition (with a full set of financial incentives) among middle-income countries and even among different regions or states of the same countries (e.g. Rodríguez-Pose and Arbix, 2001). In light of the growing importance attached to FDI by governments, it becomes imperative to take stock of available evidence on the contribution of FDI, as well as to know if FDI is generating knowledge flows particularly through certain channels and in certain sectors of developing countries.

In the following subsection we discuss the available evidence on knowledge flows with a particular focus on horizontal and vertical knowledge flows. We furthermore document the importance of certain essential ingredients that host-country firms need to possess in order to benefit from MNCs' superior technologies and competences.

3.2. Empirical evidence on the transfer/spillovers of knowledge from MNEs and the role of moderating factors

Empirical evidence provides no definitive verdict on the effect of FDI on knowledge diffusion and technological upgrading[2]. Most studies have looked at the relationship between some measure of productivity in the receiving economy and the entry of an MNE, controlling for other observable determinants of productivity at the sectoral or at the firm level. However, studies on the effect of FDI spillovers are beset by several econometric problems, rendering their conclusions far from reliable (Smeets, 2008). Endogeneity and reverse causality (e.g. between industry productivity and industry level FDI intensity), and omitted variables associated with firm, sector or country heterogeneity make it

[2] A summary of the findings are provided in Appendix table 2.

econometrically challenging to separate the effect of FDI from the productivity of host country, firm or sector (Fu et al., 2011). [3]

In spite of these limitations, certain consistent findings can be identified fairly clearly. On the one hand, horizontal spillovers within the same sector have generally proved to be weak or insignificant (e.g. Du et al., 2012; Lin et al., 2009). This might be due to the fact that foreign enterprises do not have the incentives to share their know-how with domestic firms operating in the same sector, but on the contrary are keen to avoid knowledge leakage to their potential competitors (Harrison and Rodríguez-Clare, 2009). MNE presence can even have a deleterious effect on domestic firms: the competition brought about by foreign firms–thanks to their higher productivity and innovative performances–may reduce domestic private investments (Morrissey and Udomkerdmongkol, 2012) and may even result in the exit of many domestic firms (Blomström and Kokko, 1998).

On the other hand, several empirical studies (e.g. Kugler, 2006; Xu and Sheng, 2012; Du et al., 2012) confirm that FDI generates vertical knowledge flows especially through backward linkages—the relationship that foreign affiliates have with their local suppliers. In a recent study, Havranek and Irsova (2011) conducted a meta-analysis comparing and combining results from several different studies on knowledge spillovers from FDI and found the effect of average spillovers to suppliers statistically and economically significant but those to buyers statistically significant but very small in magnitude.

Furthermore, what has emerged clearly is that knowledge does not spillover automatically from foreign affiliates to local firms. In fact, the effectiveness of knowledge flows to host economies is shaped by a set of moderating factors. First and foremost, a certain level of *absorptive capacity* – defined as the "ability to recognize the value of new information, assimilate it, and apply it to commercial ends" (Cohen & Levinthal, 1990, p.128) seems to be the sine-qua-non for local firms to understand and adopt new foreign knowledge. Here, absorptive capacity is strictly related to the human capital and the R&D investments present in a certain country or organisation. Therefore, indigenous technological efforts made by domestic firms have a dual role: on the one had they increase the knowledge stock of a country and on the other they allow the country to learn and absorb foreign knowledge (Cohen & Levinthal,

[3] We do not examine here studies that have looked into the effect of FDI spillovers at the sectoral level. As pointed out by Aitken & Harrison (1999) these studies might generate biased results because the amount of FDI a sector receives is positively correlated with the productivity of that sector.

1990; Fu et al., 2011). Consequently, looking at the level of the current and past R&D expenditure that occurred in a sector is central to understanding if the sector is potentially geared to absorb external knowledge coming from inward FDI. Later, in section 4.3, we carry out a preliminary exploration of the association between domestic R&D efforts and FDI inflows.

Another factor that can influence the effectiveness of FDI is the *technology gap* between foreign and domestic firms. The catch-up literature has long argued that the potential for rapid growth is higher when technology gap between receiving and sending countries is higher (Gerschenkron, 1962; Abramovic, 1986; Fagerberg, 1987). Rather than reinventing the wheel, going through every single phase of the technological development process, technologically backward countries can leapfrog to relatively higher levels of development through the assimilation of technologies that already exist in advanced countries. Several studies, employing different methods and different measures of technological backwardness (e.g. Wang et al., 2014; Peri and Urban, 2006; Castellani and Zanfei, 2003), have found knowledge spillovers to be higher when the backwardness levels are higher.

The *legal system*, in particular the *regime of Intellectual Property Rights,* of a host country is another factor that is likely to determine, in the first instance, the decision of MNEs to invest in a certain economy, especially in R&D or in high-tech activities. Similarly, the *openness to trade* matters for FDI: unlike in the past where import substitution policies drove FDI to tap into protected host country markets, in today's world with a globally dispersed system of production, foreign firms have little incentives to invest in countries with trade barriers (Danhui, 2010; Baldwin, 2004).

Finally, the *degree of involvement of foreign firms with local enterprises* is central in facilitating possible knowledge transmission. A longstanding criticism of MNE activity has been that these firms operate in their own enclaves in host countries with little or no significant linkages with the host economy and therefore offer little learning opportunities to local firms (Aitken & Harrison 1999). In fact, evidence suggests that when MNEs import some intermediate inputs not only do spillovers not occur but local upstream suppliers get crowded out (Kugler 2006). This calls for policy intervention and in this respect some countries have allowed MNEs to operate in their territories conditional on their involvement with local firms (Naudé et al., 2013). A notable example is China which requires foreign firms investing in the country to form joint ventures with local firms; while today this policy is limited to only a few sectors, such as automobiles, it has played a key role in the global emergence of several Chinese firms.

Research on specific sectors that benefit from FDI spillovers through inter-industry linkages is scanty. One exception is Kugler (2006) which reports the presence of spillovers from MNE affiliates to upstream medium and low technology industries such as metallic equipment, chemicals, and wood. While local suppliers in these industries benefit from the transfer of technology from MNEs, local firms in industries downstream to these local suppliers are indirect beneficiaries of MNE technology transfer.

4. Trends in and patterns of worldwide FDI activities

In this section we explore the distribution of new greenfield FDI investments across sectors, countries, and specific value-chain activities. This exercise is aimed at understanding the recent trends in and patterns of worldwide FDI investments. We first highlight the heterogeneity in FDI activities in manufacturing compared to other sectors across major regions. Next, we identify the activities for which FDI is employed, distinguishing, among others, production and innovation activities. The latter signify the relatively high scientific and technological capabilities of a region that receives FDI, compared to factors such as the size of the market and resource abundance that are key to attracting manufacturing-oriented FDI. In addition, for a smaller number of countries for which data are available, we analyse the relationship between R&D efforts and FDI flows across sectors and activities with a view to reveal the potential association between foreign investments and local economies' technological capabilities.

Our analysis relies on *fDi Markets* database maintained by fDi Intelligence (a specialist division of the Financial Times) which monitors cross border Greenfield investments—foreign investments that actually involve the creation of new capital facilities in the host economy—covering all sectors and countries worldwide since 2003. Each entry is a project, meaning that the investment has not been carried out yet, but fDi Intelligence checks at a later time whether the project has been actually completed or not, and, if not, it gets deleted from the database. The database provides information on the investing company, its sector, the type of value-chain activity of the investment, the capital invested, and the number of jobs directly associated with a certain FDI project. However, since companies do not always provide information on the number of jobs created or the magnitude of investments, these two pieces

of information are often based on estimates. For this reason we base our analysis primarily on the number of projects (across years, countries, sectors and activities)[4].

In our analysis, we consider the period 2003-2011 for which the fDi Markets database includes 118,609 projects carried out by MNEs from any country in the world in any other country. The accuracy and robustness of the information reported in fDi Markets have been recently cross-checked by Crescenzi et al. (2013) who found a relatively high correlation between this dataset and the UNCTAD database on FDI flows as well as the data on new investments reported by the Euromonitor database for European countries.

The database classifies the investing firms into 272 subsectors based on their core activities. Using an internally-developed concordance table we link these subsectors to the North American Industry Classification System (NAICS) 2012 Revision and, in turn, to the International Standard Industrial Classification (ISIC) (Revision 4) of economic activities. We group the 272 subsectors into four macro-sectors of activity: Agriculture; Manufacturing; Mining, Construction & Utilities; and Services. Additionally, we take a closer look at manufacturing and services sectors: the former is subdivided into seven key sectors (Food, Beverages and Tobacco; Textiles; Paper, Wood and Printing; Chemicals , Rubber, Plastics, Fuel and Minerals; Metals; Electronics, Electrical Equipment, Machinery and Motor Vehicles; Furniture, Repair and Instalment; and Other Manufacturing) and the latter into five main sectors (Wholesale, Retail, Transportation and Storage; Professional and Business Services; Financial Services; Information and Communication; and Other Services).

We also used the classification constructed by Crescenzi et al. (2013), which is based on the taxonomy suggested by Sturgeon (2008) that classifies investments into different value chain activities. This consists of five different value chain activities that are applicable to all the sectors: headquarters (HQ);

[4] Note that the sectoral allocation would be different if the analysis was based on the capital invested instead of on the number of projects. Manufacturing, and mining and resource extraction tend to account for a larger share of capital inflows than services. Thus, even though almost 49% of the projects happen in the services sector, the service sector attracts less than 29% of capital, while manufacturing which accounts for 44% of the projects attracts 42.1% of the total capital flows reported in *fDi Markets*.

logistics & distribution; production activities; innovation; and sales[5]. Furthermore, we classify countries into four categories: industrialised economies (IEs); emerging industrial economies (EIEs); other developing economies (ODEs); and least developed countries (LDCs)[6]. Finally, in order to analyse the association between foreign investments and indigenous R&D efforts, we use sectoral R&D measures contained in the OECD ANBERD database and sectoral value added statistics reported in the OECD Annual National Accounts database and the World Development Indicators database. The OECD ANBERD database provides industrial R&D expenditure data broken down at the level of ISIC Revision 4 sectors for OECD countries and selected non-member economies. Since the ANBERD database presents significant divergences across countries in the degree of detail and the availability of the data, we focus the final part of the study on a set of 22 countries (i.e. Australia, Austria, Belgium, Canada, China, Czech Republic, Denmark, Finland, France, Germany, Italy, Japan, Norway, Poland, Portugal, Slovenia, South Korea, Spain, Sweden, Turkey, United Kingdom, and the United States) which have reported R&D expenditures for the years 2009, 2010 and 2011 in the four main sectors of our analysis as well as in the seven key sectors of manufacturing. Admittedly, a major limitation of this exercise is that it will consider only three low- and middle-income countries.

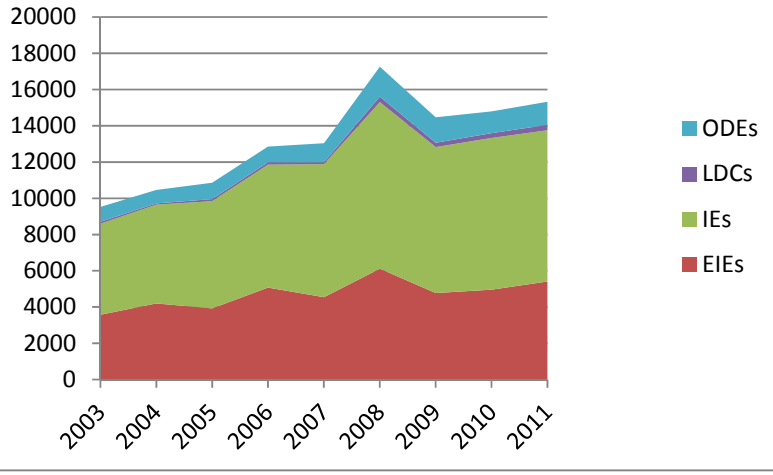
4.1. Trends in global FDI flows across country categories

We begin by discussing the trends in and patterns of global FDI inflows across the four categories of countries defined before (Figure 1). Globally, FDI flows showed a rapidly increasing trend since the early 2000s. However, the 2008 financial crisis halted this trend with the number of inward greenfield FDI projects contracting in 2009 to about 80% of what it was in the previous year. More than 45% FDI projects occur in regions other than industrialised economies (IEs). Among developing countries, the biggest category is emerging industrial economies (EIEs) that account for almost 36% of global inward greenfield FDI projects. The next biggest category is other developing economies (ODEs), whose share increased to just under 10% in 2008 and 2009 before dipping to roughly 8 % in 2010.

[5] *Innovation* includes activities in *Design, Development & Testing*, *Research & Development*, *Education & Training*. *Production* includes activities that transform inputs into outputs in *Manufacturing*, *Construction*, *Electricity*, *Extraction*, *ICT & Internet Infrastructure. Sales* includes activities classified as *Customer Contact Centre, Retail, Sales, Marketing & Support, Maintenance & Servicing, Recycling, Technical Support Centre. HQ* includes activities in *Headquarters, Business Services, Shared Services Centre. Logistics & Distribution* include activities in *Logistics, Distribution & Transportation.* For further details see Crescenzi et al. (2013). Crescenzi et al. use the somewhat confusing term manufacturing for the transformation of inputs into outputs; we have replaced this by the term production.

[6] This classification is an adapted version of the country grouping followed in UNIDO statistics (as defined in the UNIDO Working Paper 1/2013). See appendix Table 1 for the detailed list of countries in each category.

Figure 1. Number of inward FDI greenfield projects, global and by country category, 2003-2011



The trends in FDI outflows reveal a completely different picture, with IEs accounting for approximately between 88% and 93% of outward FDI projects worldwide (see Figure 2). EIEs, however, have become increasingly important as a source of global FDI flows, accounting for more than 8% of outward greenfield FDI projects in 2011. This is mainly due to the growing outward investments from India, as well as China.

Figure 2. Number of outward greenfield FDI projects, global and by country category,2003-2011

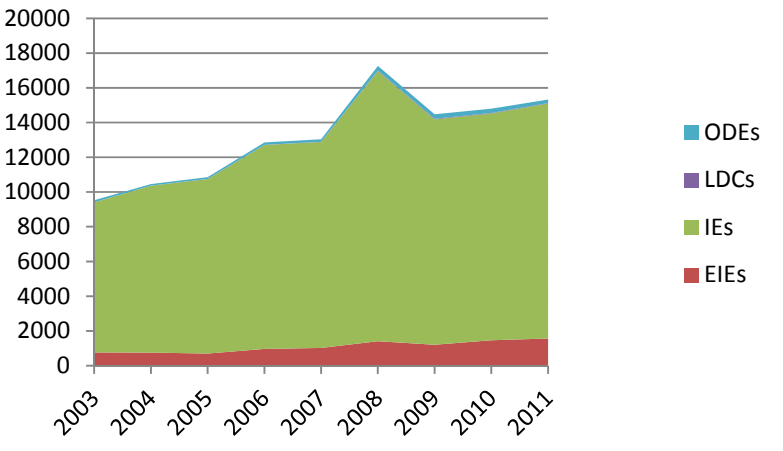


Table 1 shows that the vast majority of FDI greenfield projects originating both from emerging instustrial economies and industrialised economies goes to industrialised economies. In this respect, the international business literature highlights the growing trend of internationalisation of companies from

EIEs into IEs for not only accessing market, but also for acquiring technologieis (e.g. Duysters et al., 2009). Least developed countries, by contrast, have mainly carried out FDI projects in other least developed countries.

Table 1. Sources and destinations of greenfield FDI projects, total number of projects and country category shares, 2003-11.

		Destination								
		EIEs		**IEs**		**LDCs**		**ODEs**		**Total**	
Source	**EIEs**	3012	30.5%	4839	49.1%	392	4.0%	1618	16.4%	9861	100.0%
	IEs	39265	36.7%	59059	55.2%	880	0.8%	7817	7.3%	107021	100.0%
	LDCs	26	17.6%	25	16.9%	62	41.9%	35	23.6%	148	100.0%
	ODEs	317	20.1%	530	33.6%	300	19.0%	432	27.4%	1579	100.0%
	Total	42620	35.9%	64453	54.3%	1634	1.4%	9902	8.3%	118609	100.0%

Similar patterns hold when we look only at the manufacturing sector (Table 2). However, it is worth noting that when we consider FDI projects in manufacturing instead of the total FDI projects the share of global projects that EIEs receive is higher (40.1% versus 35.9%) and that ODEs receive is lower (6.8% versus 8.3%). This highlights that the fragmentation of manufacturing sector and the increasing globalisation of MNEs' production activities are largely confined to the relatively developed among the vast number of developing countries. Countries with smaller markets and limited manufacturing capabilities tend to remain outside of MNEs' radar.

Table 2. Sources and destinations of greenfield FDI projects in the manufacturing sector, total number of projects and country category shares, 2003-11.

		Destination								
		EIEs		**IEs**		**LDCs**		**ODEs**		**Total**	
Source	**EIEs**	1403	31.8%	2214	50.1%	155	3.5%	644	14.6%	4416	100.0%
	IEs	19481	41.0%	25010	52.6%	286	0.6%	2775	5.8%	47552	100.0%
	LDCs	10	50.0%	1	5.0%	4	20.0%	5	25.0%	20	100.0%
	ODEs	110	25.4%	112	25.9%	89	20.6%	122	28.2%	433	100.0%
	Total	21004	40.1%	27337	52.1%	534	1.0%	3546	6.8%	52421	100.0%

4.2. Trends in FDI inflows across sectors and country categories

Next, we analyse the sectoral distribution of FDI Greenfield projects across country categories (Table 3a). The bulk of the global greenfield FDI projects takes place in two sectors: services (about 49% of total projects) and manufacturing (44%), followed by Mining, Construction and Utilities (7%) and, to a very

small extent, agriculture (0.2%). Among developing countries, while manufacturing is the leading recipient of FDI projects in EIEs, in LDCs and ODEs services account for the majority of projects (respectively 47% and 50%), followed by a substantial proportion of 'resource-driven' projects in Mining, Construction and Utilities (respectively 19% and 14%).

Table 3a. Number of inward greenfield FDI projects per sector and group of economies, total 2003-2011.

	Agriculture		Manufacturing		Mining, Const. & Utilities		Services		Total	
EIEs	86	0.2%	21004	49.3%	3087	7.24%	18443	43.3%	42620	100%
IEs	74	0.1%	27337	42.4%	3372	5.23%	33670	52.2%	64453	100%
LDCs	19	1.2%	534	32.7%	313	19.16%	768	47.0%	1634	100%
ODEs	50	0.5%	3546	35.8%	1399	14.13%	4907	49.6%	9902	100%
Total	229	0.2%	52421	44.2%	8171	6.89%	57788	48.7%	118609	100%

If we look at the amount of investment (Table 3b), rather than the number of projects the share of mining, construction and utilities increases (i.e. M,C & U attract 29% of the FDI capital invested and just about 6.9% in terms of the number of projects). However, this is not the case for manufacturing (which attracts 42.1% of capital and 44% of the projects). Services projects are on average quite small (they attract 28.6% of capital and 48.7% of projects). Though the investment figures needed to be interpreted with caution as the data on investment figures are less reliable, they reinforce the importance of the manufacturing sector as a key destination of FDI.

Table 3b. Inward greenfield FDI per sector and group of economies, total 2003-2011 (USD millions).

	Agriculture		Manufacturing		Mining, Const. & Utilities		Services		Total	
EIEs	10043	0.4%	1377101	49.0%	642676	22.9%	779709	27.8%	2809528	100%
IEs	1941	0.1%	1127394	41.0%	736507	26.8%	882501	32.1%	2748342	100%
LDCs	1050	0.6%	52569	28.2%	97987	52.5%	35116	18.8%	186722	100%
ODEs	5050	0.4%	362066	30.4%	535884	45.1%	286395	24.1%	1189395	100%
Total	18084	0.3%	2919130	42.1%	2013054	29.0%	1983720	28.6%	6933988	100%

Next, we breakdown FDI flows in each sector into their activities of focus (Table 4). Globally, major activities in which FDI projects take place relate to sales (37%) and production (34%), followed by HQ (18%), logistics (5%), and innovation (7%). Not surprisingly, across sectors, and, in particular, between manufacturing and services industries, the relative share of production activities and sales shows considerable variations. Production activities in manufacturing and services sectors respectively account

for more than half and only one tenth of all projects, while sales-related activities account for 31% and 46% of projects in the respective sectors. Aside from sales, HQ-related activities are an important activity (30%) in the services sector.

In the following subsection, we explore in depth the type of activities undertaken across country groups and major industries by MNEs operating in the manufacturing sector.

Table 4. Number of inward FDI Greenfield projects per sector, country categories and activity, 2003-2011.

		HQ		Innovation		Logistics & Distribution		Production		Sales	
Agriculture	**EIEs**	0	0.0%	7	8.1%	2	2.3%	63	73.3%	14	16.3%
	IEs	3	4.1%	4	5.4%	2	2.7%	49	66.2%	16	21.6%
	LDCs	0	0.0%	1	5.3%	0	0.0%	16	84.2%	2	10.5%
	ODEs	2	4.0%	4	8.0%	0	0.0%	41	82.0%	3	6.0%
Manufacturing	**EIEs**	455	2.2%	1669	7.9%	529	2.5%	13252	63.1%	5099	24.3%
	IEs	1759	6.4%	2483	9.1%	1289	4.7%	11874	43.4%	9932	36.3%
	LDCs	7	1.3%	6	1.1%	9	1.7%	385	72.1%	127	23.8%
	ODEs	61	1.7%	108	3.0%	100	2.8%	2306	65.0%	971	27.4%
Mining, Const. & Utilities	**EIEs**	146	4.7%	28	0.9%	47	1.5%	2572	83.3%	294	9.5%
	IEs	315	9.3%	84	2.5%	71	2.1%	2383	70.7%	519	15.4%
	LDCs	4	1.3%	1	0.3%	2	0.6%	285	91.1%	21	6.7%
	ODEs	71	5.1%	7	0.5%	11	0.8%	1180	84.3%	130	9.3%
Services	**EIEs**	5152	27.9%	1622	8.8%	1256	6.8%	2005	10.9%	8408	45.6%
	IEs	11154	33.1%	1511	4.5%	2120	6.3%	2531	7.5%	16354	48.6%
	LDCs	410	53.4%	23	3.0%	29	3.8%	120	15.6%	186	24.2%
	ODEs	1717	35.0%	205	4.2%	291	5.9%	821	16.7%	1873	38.2%

4.2.1. Inward FDI projects in the manufacturing sector

When we look closely at the inward FDI projects made by companies operating in the manufacturing sector, quite diverse patterns of value-chain activities across different economies emerge. Table 4 shows that in Emerging Industrial Economies most of the manufacturing-sector projects go into production activities (approx. 63%) whereas in industrialised economies production activities represent only 43% of the total number of projects occurring in the manufacturing sector. In fact, sales and, to a certain degree, innovation activities take up a much larger share in IEs than in EIEs (respectively over 36% and 9% of the inward manufacturing sector FDI projects in IEs versus over 24% and 7.5 % in EIEs).

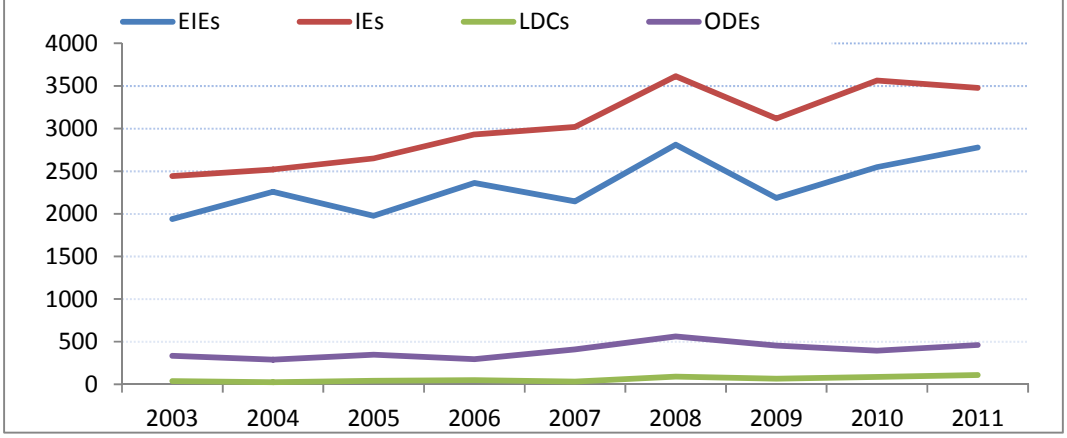
Table 5 indicates that four of the top ten receivers of FDI projects in the manufacturing sector are EIEs—China, India, Brazil, and Poland. Furthermore, in FDI projects in the manufacturing sector focused on innovation activities China and India rank number one and two respectively worldwide. In terms of the proportion of FDI projects in manufacturing with an innovation focus, India ranks first (16%), China ranks third (10%), while Brazil (1%) and Poland rank lowest (2%) among the set of ten countries. In contrast, Brazil and Poland have the highest proportion (72% and 70% respectively) of production-oriented FDI projects in the manufacturing sector, while amongst EIEs this proportion is the lowest for India (51%)—a share that is comparable to that of the USA (50%).

Table 5. Top-10 receivers of greenfield FDI projects in the manufacturing sector. Number of projects per type of activity, and total projects, 2003-2011.

		HQ	Innovation	Logistics & Distribution	Production	Sales	Total
1.	**China**	205	729	139	4642	1645	7360
2.	**United States**	477	405	235	2462	1297	4876
3.	**India**	77	548	53	1718	949	3345
4.	**UK**	165	296	108	740	1020	2329
5.	**Germany**	170	182	102	729	973	2156
6.	**Russia**	22	58	80	1252	535	1947
7.	**France**	62	168	89	823	647	1789
8.	**Brazil**	12	81	34	949	248	1324
9.	**Poland**	31	46	59	908	244	1288
10.	**Spain**	61	87	57	552	465	1222

Comparison over time of the distribution of inward manufacturing FDI investments across different groups of economies (Figure 3), indicates that the gap between IEs and EIEs in 2003 and in 2011 remained rather stable (approximately 51% of the total number of projects in the manufacturing sector went to IEs and about 41% went to EIEs). However, in the years immediately after the beginning of the financial crisis (i.e. 2009 and 2010) the gap between IEs and EIEs increased significantly.

Figure 3. Number of inward FDI greenfield projects in manufacturing per country category, 2003 - 2011



We now explore the distribution of the FDI projects across key manufacturing industries (Table 6). We observe rather similar patterns for IEs and EIEs: in both these groups of economies, almost one out of two projects (48.9% in EIEs and 47% in IEs) goes into Electronics, Electrical Equipment, Machinery & Motor vehicles. The medium- and low-tech category of industries Chemicals, Rubber, Plastics, Fuel & Minerals, is a major receiver of FDI projects across all country categories. On the other hand, the share of greenfield FDI projects in the natural resource-based sector Food, Beverage and Tobacco is significantly higher in ODEs and LDCs than in EIEs and IEs. In general, the resource-intensive sectors (metals, food, furniture, textiles, and paper) collectively account for a much larger share of FDI projects in LDCs and ODEs (43% and 33% respectively), compared to EIEs and IEs (25% and 26% respectively). Note in this respect that, as Table 4 reveals, manufacturing FDI projects that are focused on innovation activities happen almost entirely in EIEs and IEs (only 114 out of 4266 projects in innovation activities happened in LDCs or ODEs).

Overall, the discussion so far appears to lend partial support to the argument, discussed earlier, that globalisation of manufacturing activities may be following a pattern of concentrated dispersion in that FDI projects in innovation activities remain largely confined to either IEs or EIEs, with non-EIE developing countries still receiving proportionally more FDI projects in low-tech, natural resource-based manufacturing.

Table 6. Inward Greenfield FDI projects in manufacturing industries per group of economies, total 2003-2011.

	EIEs	IEs	LDCs	ODEs	Total
Electronics, Electrical Equipment, Machinery, Motor vehicles	48.9%	47.0%	28.1%	38.0%	47.0%
Chemicals, Rubber, Plastics, Fuel & Minerals	26.8%	26.5%	28.7%	29.1%	26.8%
Metals	9.2%	8.2%	12.9%	10.4%	8.8%
Food, Beverages, Tobacco	6.9%	6.6%	21.3%	13.7%	7.4%
Furniture, Repair and Installment, Other	3.9%	5.6%	2.4%	3.1%	4.7%
Textiles	2.2%	2.9%	4.9%	3.7%	2.7%
Paper, Wood, Printing	2.3%	3.1%	1.7%	2.1%	2.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

In the following subsection, similar to the exercise in the current subsection for projects in the manufacturing sector, we explore FDI projects in the services sector.

4.2.2. Inward FDI projects in the services sector

Some interesting facts about the distribution of FDI projects into value chain activities emerge when we look at projects made by companies operating in the services sector. First of all, as noted before the types of activities that foreign companies invest in the most are those related to sales. This is true for EIEs, IEs and for ODEs (of all the projects in the services sector, sales-related activities account for over 45% in EIEs, 48% in IEs and 38% in ODEs). The number of FDI projects in the services sector that are for innovation activities is rather low, but it is worth noting that, in relative terms, it is almost double in EIEs than in IEs—8.8 % of the FDI projects in the services sector go into innovation activities in EIEs whereas in IEs this is true for only 4.5% of the services sector projects.

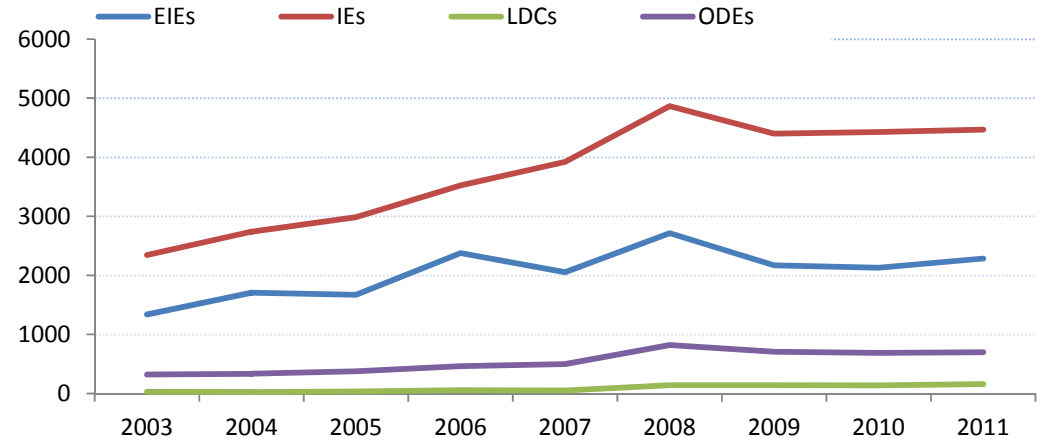
When we look at individual countries (Table 7), we see that two of the top ten receivers of FDI projects in services worldwide are EIEs (i.e. China and India), while all the others are IEs. Interestingly, while China was the largest recipient of projects in production activities, India accounted for nearly twice the number of projects as China in innovation activities. On the other hand, HQ activities tend to concentrate in China, the UK and the US.

Table 7. Top-10 receivers of greenfield FDI projects in the services sector. Number of projects per kind of activity, total 2003-2011.

		HQ	Innovation	Logistics & Distribution	Production	Sales	Total
1.	**China**	1457	386	389	418	2099	4749
2.	**UK**	1372	181	206	338	2176	4273
3.	**United States**	1359	139	184	197	1757	3636
4.	**India**	896	795	183	278	1261	3413
5.	**Germany**	735	70	174	161	1114	2254
6.	**France**	507	75	171	103	1069	1925
7.	**Spain**	411	88	158	89	1010	1756
8.	**UAE**	786	77	61	174	644	1742
9.	**Russia**	440	55	122	189	928	1734
10.	**Singapore**	635	100	54	87	452	1328

The pattern over time of inward FDI projects in services across country categories looks rather similar to what we have observed for the manufacturing sector (Figure 4), with IEs maintaining their dominant position followed by EIEs. The number of projects in services in LDCs—even though still very marginal in absolute terms—registered a fivefold increase between 2003 and 2011; the number of projects in IEs, EIEs and ODEs also increased but at a slower pace.

Figure 4. Number of inward FDI greenfield projects in services per country category, 2003 - 2011



Finally, we explore the distribution of projects across major services sectors for each group of economies. We find that in both EIEs and IEs, most of the FDI projects are directed towards Wholesale, Retail, Transportation & Storage Services and Information & Communication Services. In contrast, in LDCs and ODEs a remarkable share of the FDI greenfield projects are in financial services (Table 8). The

low share of Information & Communication Services in FDI projects in these economies underscores the challenges low income countries face in bridging the digital divide.

Table 8. Inward greenfield FDI projects in services sectors per group of economies, total 2003-2011.

	EIEs	IEs	LDCs	ODEs	Total
Wholesale, retail, transportation and storage	32.1%	29.2%	17.3%	24.3%	29.6%
Information and communication	25.4%	30.1%	15.8%	19.1%	27.5%
Financial services	16.4%	16.3%	46.6%	25.9%	17.5%
Professional and business services	13.7%	15.7%	9.0%	15.3%	14.9%
Other services	12.4%	8.7%	11.3%	15.4%	10.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

A key question that stems from our discussion so far is to what extent are FDI inflows associated with local R&D capabilities? The following subsection makes a modest attempt to answer this question, but due to data limitations this exercise is limited to only three low- and middle-income countries, with the rest of the countries analysed being OECD economies.

4.3. Preparing the ground for spillovers: domestic R&D investments and FDI inflows

As already discussed, a *sine-qua-non* for FDI inflows in knowledge intensive sectors and activities and, in particular, for the generation of spillovers is an appropriate level of absorptive capacity. In an attempt to link absorptive capacity present in a certain sector to the FDI inflows arriving in that sector, we analyse the association between yearly R&D expenditure and yearly number of greenfield FDI projects across sectors. Two limitations of this exercise are, one R&D is an imperfect indicator of absorptive capacity especially in low-income countries where much of technological learning occurs on the factory floor, and two we could obtain comparable R&D data for only three low- and middle income countries. Due to data limitations, we restrict the analysis to 21 countries, four macro-sectors, and the latest year of our study (2011). In spite of these limitations we hope to gain some broad insights in regard to whether new FDI projects are actually taking place in the countries and sectors with higher R&D efforts.

It emerges from Table 9 that China stands out as the number one country in terms of R&D expenditure at the manufacturing sector level. Even the R&D intensity (in parenthesis) of its manufacturing sector is higher than that of most OECD countries, but still lower than that of another regional industrial powerhouse, South Korea.

Table 9a. Sectoral R&D expenditure in billion PPP USD, sectoral shares of R&D expenditure, and sectoral R&D intensity (in parenthesis).

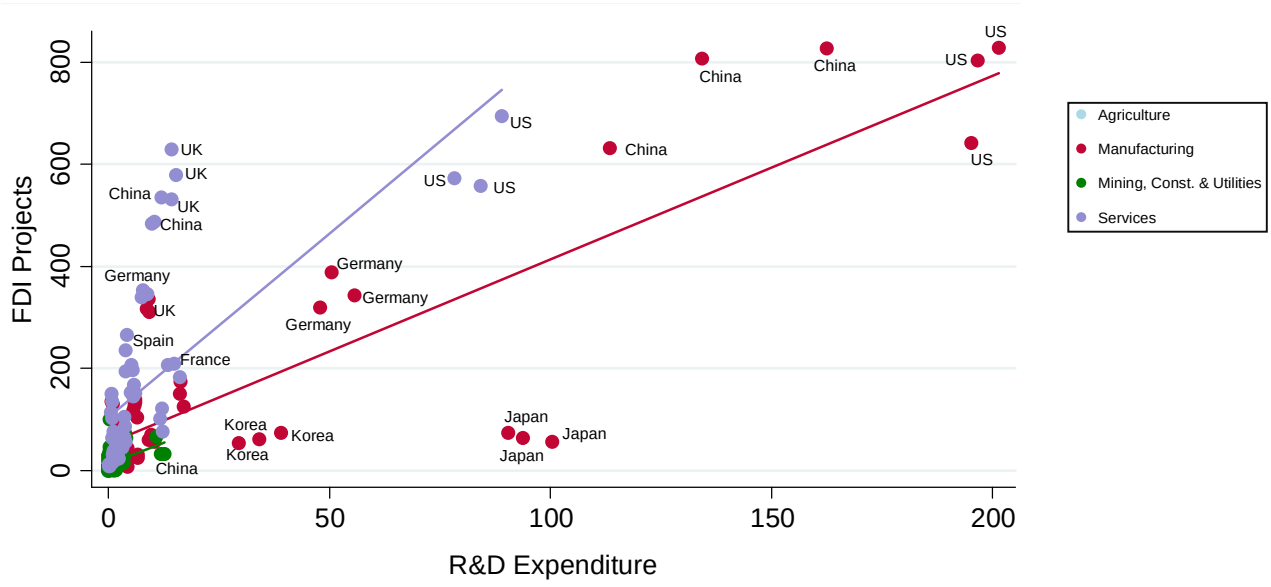
	Agriculture			Manufacturing			Mining, Const. & Utilities			Services		
Low and Middle-Income Countries												
China	0.48	0.26%	(0.04%)	162.47	86.56%	(3.78%)	12.69	6.76%	(0.64%)	12.05	6.42%	(0.21%)
Poland	0.01	0.77%	(0.06%)	0.95	49.15%	(0.70%)	0.05	2.76%	(0.05%)	0.91	47.32%	(0.19%)
Turkey	0.01	0.27%	(0.01%)	2.59	53.34%	(1.23%)	0.07	1.36%	(0.06%)	2.19	45.04%	(0.30%)
High-Income Countries												
Australia	0.13	1.04%	(0.56%)	2.98	24.57%	(4.29%)	3.51	28.94%	(1.85%)	5.51	45.46%	(0.86%)
Austria	0.00	0.03%	(0.04%)	4.34	63.69%	(7.02%)	0.09	1.29%	(0.27%)	2.38	34.98%	(1.04%)
Belgium	0.03	0.46%	(1.09%)	4.21	62.93%	(7.13%)	0.14	2.14%	(0.40%)	2.30	34.48%	(0.75%)
Canada[(1)]	0.11	0.83%	(0.55%)	6.03	46.62%	(4.41%)	1.05	8.11%	(0.48%)	5.75	44.44%	(0.63%)
Czech Republic	0.01	0.33%	(0.13%)	1.46	56.23%	(2.19%)	0.04	1.50%	(0.11%)	1.09	41.94%	(0.66%)
Denmark	0.01	0.14%	(0.21%)	2.48	51.94%	(9.34%)	0.05	0.99%	(0.21%)	2.24	46.92%	(1.43%)
Finland	0.01	0.10%	(0.11%)	4.27	76.83%	(12.06%)	0.12	2.17%	(0.64%)	1.16	20.90%	(0.90%)
France	0.18	0.52%	(0.44%)	17.00	49.75%	(6.82%)	0.81	2.37%	(0.44%)	16.18	47.36%	(0.94%)
Germany	0.16	0.25%	(0.65%)	55.77	85.62%	(7.93%)	0.35	0.53%	(0.15%)	8.86	13.60%	(0.42%)
Italy	0.00	0.03%	(0.01%)	10.36	73.60%	(3.43%)	0.15	1.07%	(0.09%)	3.56	25.30%	(0.25%)
Japan	0.03	0.02%	(0.05%)	100.35	87.87%	(12.35%)	1.56	1.37%	(0.47%)	12.26	10.74%	(0.39%)
Korea	0.04	0.09%	(0.12%)	39.11	87.54%	(8.81%)	1.57	3.51%	(1.58%)	3.96	8.85%	(0.47%)
Norway	0.08	3.14%	(1.98%)	0.98	37.07%	(4.66%)	0.35	13.08%	(0.37%)	1.23	46.70%	(0.78%)
Portugal	0.00	0.24%	(0.09%)	0.70	35.48%	(2.16%)	0.05	2.42%	(0.21%)	1.21	61.86%	(0.64%)
Slovenia	0.00	0.08%	(0.07%)	0.76	72.08%	(7.07%)	0.02	1.69%	(0.35%)	0.27	26.15%	(0.81%)
Spain	0.14	1.32%	(0.40%)	5.85	55.70%	(3.10%)	0.68	6.44%	(0.42%)	3.84	36.54%	(0.38%)
Sweden	0.02	0.25%	(0.38%)	6.59	71.86%	(9.91%)	0.05	0.51%	(0.13%)	2.51	27.38%	(0.98%)
United Kingdom	0.02	0.07%	(0.13%)	9.18	36.90%	(4.39%)	0.35	1.40%	(0.16%)	15.33	61.63%	(0.95%)
United States	-	-	-	201.36	-	(10.56%)	3.79	-	(0.30%)	88.95	-	(0.73%)

Note: Values refer to year 2011. The sectoral R&D intensity is computed dividing the sectoral R&D expenditure (in current local currency) by the sectoral Value Added (in current local currency), i.e. *R&D intensity* $_{i,j} = R_{i,j} / Y_{i,j}$ where $R_{i,j}$ is the R&D expenditure of sector *i* in country *j* and $Y_{i,j}$ is the Value Added of sector *i* in country *j*.
Source: Own elaboration based on OECD ANBERD database, on OECD Annual National Accounts database and on World Development Indicators database (for the countries highlighted in blue).
(1) Values refer to 2010.

When we compare the sectoral R&D expenditures to the numbers of FDI projects financed in the same year, we note that the two variables tend to move together (see Figure 5) and that the correlation coefficient is the highest for manufacturing (0.85 in Manufacturing, 0.69 in Services and 0.40 in Mining,

Construction and Utilities)[7]. This highlights the challenges facing low incomes countries in that their capabilities need to be scaled up in order to be able to attract FDI into manufacturing, as well as into services; right now, as our discussion before revealed, a major part of FDI flows into ODEs and LDCs occur in natural-resource intensive sectors such as oil & gas.

Figure 5. R&D Expenditure (in billion PPP USD) and number of FDI projects, 2009-2011.



[7] It must be kept in mind that the size of the economies and their sectoral distribution explain a remarkably large part of these correlations. In fact, when we compare the sectoral R&D intensities to the number of FDI projects per sector, the correlations gets lower; nonetheless, manufacturing continues to show the highest values relative to the other three sectors.

5. Conclusions

Perhaps the single most important feature of economic globalisation over the last 25 years has been the growing importance of FDI and of the increasingly geographically dispersed nature of global production. As the integration of global markets has intensified global competition, factors such as flexibility or speed-to-market have become keys to achieving competitive advantage, forcing firms to rely on resources and competences that are widely dispersed all around the world. Vast improvements in transport and communication and the shift away from the import substituting industrialisation strategies in most parts of the world have played a key facilitating role in the growth of FDI. To take advantage of this trend, national governments, as well as regions within many countries, have been vying with each other offering incentives to MNEs to invest in their countries or regions.

Our analysis of the empirical literature on FDI spillovers provide qualified support for the effectiveness of FDI in creating technology spillovers and in bringing about improvements in domestic technological capabilities in host economies. Evidence suggests that spillovers tend to occur along the value chain, from foreign companies to local suppliers, but also, to a smaller extent, to local clients (vertical spillovers). However, there is very little evidence that FDI would generate spillovers to local firms that compete with MNEs (horizontal spillovers). This is an important finding in light of the fears that MNE affiliates may outcompete local firms and may exert monopolistic control over the local market.

Our review of the literature further revealed that there are certain important factors that moderate the influence of FDI on host economies. Among these, absorptive capacity is the most important one in that without it very little inflow of knowledge intensive FDI would take place in the first instance and domestic firms would not be able to assimilate knowledge that is available with foreign affiliates. This means that developing countries need to focus on strengthening the quality of their workforce, particularly that which is engaged in knowledge intensive activities, and increase R&D activities and improve their effectiveness. Other factors that are relevant in this context include a strong legal and IPR regime that instils confidence in MNEs to undertake FDI in a given country.

Although a large and growing body literature exists on the effectiveness of FDI in generating knowledge spillovers, little is known about the distribution of FDI across sectors and across specific activities in major economic regions around the world. Our study makes a first contribution in this regard using a novel data set that identifies sectors and activities where FDI occurs. We find that while FDI has been growing rapidly over the past years, more than 45% of greenfield FDI projects is directed to countries

other than industrialised economies. Emerging Industrial Economies account for more than one third of the global inward FDI projects, while Other Developing Economies receive close to 10% of world inward FDI projects. As sources of FDI, Industrialised Economies, which are home to majority of MNEs, are a dominant force, accounting for approximately 90% of FDI outflows world over. However, EIEs such as India and China are increasingly emerging as important sources of FDI.

A breakdown of FDI inflows across sectors and across value chain activities for country categories revealed interesting facts. Four out of the top ten receivers of FDI in the manufacturing sector are EIEs, while the other six are IEs. Inward FDI goes mainly to high- or medium-high tech manufacturing in IEs and EIEs whereas ODEs and LDCs tend to attract relatively more projects in medium and low tech manufacturing. Interestingly, when we look at the specific value chain segments that FDI flows into, China and India emerge as the two countries that received the highest number of FDI projects for innovation activities in both manufacturing and services sectors. This is in line with observations made in the literature (e.g. Franco et al., 2011; Schmitz and Strambach, 2009) that in recent years emerging economies are attracting increasingly more knowledge-based FDI. Finally, when we compare the sectoral R&D expenditures to the numbers of FDI projects financed in the same year, we find the highest correlation coefficient for Manufacturing and rather low correlations for Agriculture and for Mining, Construction and Utilities. This indicates that especially in the manufacturing sector (and to a lesser extent in the service sector) MNEs tend to invest more when domestic technological efforts - which increase the local absorptive capacities and the possibilities for spillovers – are higher.

Overall, the findings of this study points to the heterogeneous nature of FDI flows across countries and across sectors. Most knowledge-intensive FDI projects tend to be concentrated in advanced economies and a few emerging economies. Non-EIE developing countries tend to receive a proportionately higher share of FDI projects in natural-resource intensive sectors such as, in particular, mining and construction. Given the high correlation that we found between host-country R&D capabilities and FDI flows into manufacturing sector (and into innovation activities) a major challenge for low-income countries in attracting such FDI is overcoming their rather weak technological capabilities. Our discussion also underlined that it is not enough to attract FDI, but that countries need to ensure the involvement of foreign affiliates with local companies. Absent close involvement between foreign firms and local firms, spillovers to local firms may not occur, and, even worse, foreign firms may crowd out local firms and create foreign enclaves that have considerable welfare-reducing consequences.

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Appendix tables

Appendix table 1. Country classification

Country	Group
Afghanistan	LDCs
Albania	ODEs
Algeria	ODEs
Andorra	IEs
Angola	ODEs
Anguilla	ODEs
Antigua	ODEs
Antigua and Barbuda	ODEs
Argentina	EIEs
Armenia	ODEs
Aruba	IEs
Australia	IEs
Austria	IEs
Azerbaijan	ODEs
Bahamas	ODEs
Bahrain	IEs
Bangladesh	LDCs
Barbados	ODEs
Belarus	EIEs
Belgium	IEs
Belize	ODEs
Benin	LDCs
Bermuda	IEs
Bhutan	LDCs
Bolivia	ODEs
Bosnia-Herzegovina	ODEs
Botswana	ODEs
Brazil	EIEs
British Virgin Islands	IEs
Brunei	EIEs
Bulgaria	EIEs
Burkina Faso	LDCs
Burundi	LDCs
Cambodia	LDCs
Cameroon	ODEs
Canada	IEs
Cape Verde	ODEs
Cayman Islands	ODEs
Central African Republic	LDCs
Chad	LDCs
Chile	EIEs
China	EIEs
Colombia	EIEs
Comoros	LDCs
Congo (DRC)	LDCs
Cook Islands	ODEs
Costa Rica	EIEs
Cote d'Ivoire (Ivory Coast)	ODEs
Croatia	EIEs
Cuba	ODEs
Curaçao	IEs
Cyprus	EIEs
Czech Republic	IEs
Côte d'Ivoire	ODEs
Denmark	IEs
Djibouti	LDCs
Dominica	ODEs
Dominican Republic	ODEs
Ecuador	ODEs
Egypt	ODEs
El Salvador	ODEs
Equatorial Guinea	ODEs
Eritrea	LDCs
Estonia	IEs
Ethiopia	LDCs
Fiji	ODEs
Finland	IEs
France	IEs
French Guiana	IEs
French Polynesia	IEs
Gabon	ODEs
Gambia	LDCs
Georgia	ODEs
Germany	IEs
Ghana	ODEs
Greece	EIEs
Greenland	IEs
Grenada	ODEs
Guadeloupe	ODEs

Guam	IEs	Mauritius	EIEs
Guatemala	ODEs	Mexico	EIEs
Guinea	LDCs	Micronesia	ODEs
Guinea Bissau	LDCs	Moldova	ODEs
Guyana	ODEs	Monaco	IEs
Haiti	LDCs	Mongolia	ODEs
Honduras	ODEs	Montenegro	ODEs
Hong Kong	IEs	Montserrat	ODEs
Hungary	IEs	Morocco	ODEs
Iceland	IEs	Mozambique	LDCs
India	EIEs	Myanmar (Burma)	LDCs
Indonesia	EIEs	Namibia	ODEs
Iran	ODEs	Nepal	LDCs
Iraq	ODEs	Netherlands	IEs
Ireland	IEs	New Caledonia	IEs
Israel	IEs	New Zealand	IEs
Italy	IEs	Nicaragua	ODEs
Jamaica	ODEs	Niger	LDCs
Japan	IEs	Nigeria	ODEs
Jordan	ODEs	North Korea	ODEs
Kazakhstan	EIEs	Norway	IEs
Kenya	ODEs	Oman	EIEs
Kiribati	LDCs	Pakistan	ODEs
Kuwait	IEs	Palau	ODEs
Kyrgyzstan	ODEs	Palestine	ODEs
Laos	LDCs	Panama	ODEs
Latvia	EIEs	Papua New Guinea	ODEs
Lebanon	ODEs	Paraguay	ODEs
Lesotho	LDCs	Peru	ODEs
Liberia	LDCs	Philippines	ODEs
Libya	ODEs	Poland	EIEs
Liechtenstein	IEs	Portugal	IEs
Lithuania	IEs	Puerto Rico	IEs
Luxembourg	IEs	Qatar	IEs
Macau	IEs	Republic of the Congo	ODEs
Macedonia FYR	EIEs	Reunion	ODEs
Madagascar	LDCs	Romania	EIEs
Malawi	LDCs	Russia	IEs
Malaysia	IEs	Rwanda	LDCs
Maldives	ODEs	Saint Kitts & Nevis	ODEs
Mali	LDCs	Saint Vincent and the Grenadines	ODEs
Malta	IEs	Samoa	LDCs
Marshall Islands	ODEs	San Marino	IEs
Martinique	ODEs	Sao Tome and Principe	LDCs
Mauritania	LDCs	Saudi Arabia	EIEs

Senegal	LDCs
Serbia	EIEs
Seychelles	ODEs
Sierra Leone	LDCs
Singapore	IEs
Slovakia	IEs
Slovenia	IEs
Solomon Islands	LDCs
Somalia	LDCs
South Africa	EIEs
South Korea	IEs
South Sudan	LDCs
Spain	IEs
Sri Lanka	ODEs
St Lucia	ODEs
Sudan	LDCs
Suriname	EIEs
Swaziland	ODEs
Sweden	IEs
Switzerland	IEs
Syria	ODEs
Taiwan	IEs
Tajikistan	ODEs
Tanzania	LDCs
Thailand	EIEs
Timor-Leste	LDCs
Togo	LDCs
Tonga	ODEs
Trinidad & Tobago	ODEs
Tunisia	EIEs
Turkey	EIEs
Turkmenistan	ODEs
Turks and Caicos Islands	ODEs
UAE	IEs
UK	IEs
Uganda	LDCs
Ukraine	EIEs
United States	IEs
United States Virgin Islands	IEs
Uruguay	EIEs
Uzbekistan	ODEs
Vanuatu	LDCs
Venezuela	EIEs
Vietnam	ODEs
Yemen	LDCs
Zambia	LDCs
Zimbabwe	ODEs

Appendix Table 2. Empirical studies on the effects of backward and forward linkages, workers' mobility and horizontal/demonstration effects on FDI knowledge spillovers.

Channel	Study	Sample	Effect
Backward and forward linkages	Javorcik (2004b)	4000 firms in Lithuania, 1996–2000	Positive effects through backward linkages; no effects through forward linkages
	Javorcik and Spatareanu (2008)	13129 firms in Romania, 1998–2003	Positive effects through backward linkages
	Kugler (2006)	All manufacturing plants in Colombia, 1974-1998	Positive effects through backward linkages; no effects through forward link
	Bwalya (2006)	125 Zambian manufacturing firms, 1993-1995	Positive effects through backward linkages; no effects through forward linkages
	Schoors and van der Tol (2001)	1084 firms in Hungary, 1997–98	Positive effects through backward linkages; negative effects through forward linkages
	Xu and Sheng (2012)	169810 firms in the mining, manufacturing and public-utility sectors in China, 2000-2003	Positive effects through forward linkages; negative effects through backward linkages
	Du, Harrison and Jefferson (2012)	336768 manufacturing firms in China, 1998 - 2007	Positive effects through both backward linkages and forward linkages
	Newman et al. (2015)	4248 manufacturing firms in Vietnam, 2009-12	Positive effects through backward linkages; negative effects through forward linkages
Mobility of (highly-skilled) workers	Markusen and Trofimenko (2007)	304 manufacturing establishments in Colombia, 1977–91	Positive effects
	Görg and Strobl (2005)	228 manufacturing firms in Ghana, 1991–97	Positive effects
	Poole (2008)	Formal sector workers in Brazil, 1996–2001	Positive effects
	Hale and Long (2006)	1,500 firms in China, 2000	Positive effects
Horizontal and demonstration effects	Cheung and Lin (2004)	26 provinces in China, 1995–2000	Positive effects
	Hale and Long (2006)	1500 firms in China, 2000	Positive effects
	Xu and Sheng (2012)	169810 firms in the mining, manufacturing and public-utility sectors in China, 2000-03	Negative effects
	Du, Harrison and Jefferson (2012)	336768 manufacturing firms in China, 1998 - 2007	No effects

Source: Own research based on Smeets (2008).

Appendix Table 3. Inward greenfield FDI Projects in manufacturing industries: By group of economies and value-chain activities, total 2003-2011.

		HQ		Innovation		Logistics & Distribution		Manufacturing		Sales		Total	
Chemicals, Rubber, Plastics, Fuel & Minerals	**EIEs**	90	1.6%	498	8.8%	163	2.9%	3819	67.9%	1058	18.8%	5628	100.0%
	IEs	414	5.7%	827	11.4%	309	4.3%	3743	51.7%	1948	26.9%	7241	100.0%
	LDCs	0	0.0%	2	1.3%	3	2.0%	117	76.5%	31	20.3%	153	100.0%
	ODEs	13	1.3%	23	2.2%	37	3.6%	736	71.4%	222	21.5%	1031	100.0%
Electronics, Electrical Equipment, Machinery, Motor vehicles	**EIEs**	270	2.6%	1023	10.0%	193	1.9%	6140	59.8%	2636	25.7%	10262	100.0%
	IEs	967	7.5%	1396	10.9%	589	4.6%	4915	38.2%	4986	38.8%	12853	100.0%
	LDCs	5	3.3%	2	1.3%	2	1.3%	73	48.7%	68	45.3%	150	100.0%
	ODEs	33	2.4%	72	5.3%	27	2.0%	687	51.0%	528	39.2%	1347	100.0%
Food, Beverages, Tobacco	**EIEs**	34	2.3%	49	3.4%	77	5.3%	1099	76.0%	188	13.0%	1447	100.0%
	IEs	113	6.2%	98	5.4%	119	6.6%	1139	62.7%	347	19.1%	1816	100.0%
	LDCs	0	0.0%	2	1.8%	2	1.8%	104	91.2%	6	5.3%	114	100.0%
	ODEs	9	1.9%	8	1.6%	23	4.7%	394	81.1%	52	10.7%	486	100.0%
Furniture, Repair and Installment, Other	**EIEs**	26	3.2%	32	4.0%	21	2.6%	378	46.7%	353	43.6%	810	100.0%
	IEs	144	9.4%	92	6.0%	110	7.2%	427	27.8%	761	49.6%	1534	100.0%
	LDCs	1	7.7%	0	0.0%	0	0.0%	8	61.5%	4	30.8%	13	100.0%
	ODEs	2	1.8%	1	0.9%	4	3.6%	49	44.5%	54	49.1%	110	100.0%
Metals	**EIEs**	28	1.5%	49	2.5%	50	2.6%	1220	63.4%	577	30.0%	1924	100.0%
	IEs	73	3.2%	46	2.0%	115	5.1%	909	40.4%	1108	49.2%	2251	100.0%
	LDCs	1	1.4%	0	0.0%	2	2.9%	57	82.6%	9	13.0%	69	100.0%
	ODEs	4	1.1%	3	0.8%	6	1.6%	279	75.6%	77	20.9%	369	100.0%
Paper, Wood, Printing	**EIEs**	5	1.1%	10	2.1%	15	3.2%	386	81.6%	57	12.1%	473	100.0%
	IEs	26	3.1%	15	1.8%	33	3.9%	624	74.6%	138	16.5%	836	100.0%
	LDCs	0	0.0%	0	0.0%	0	0.0%	8	88.9%	1	11.1%	9	100.0%
	ODEs	0	0.0%	0	0.0%	1	1.4%	68	93.2%	4	5.5%	73	100.0%
Textiles	**EIEs**	2	0.4%	8	1.7%	10	2.2%	210	45.7%	230	50.0%	460	100.0%
	IEs	22	2.7%	9	1.1%	14	1.7%	117	14.5%	644	79.9%	806	100.0%
	LDCs	0	0.0%	0	0.0%	0	0.0%	18	69.2%	8	30.8%	26	100.0%
	ODEs	0	0.0%	1	0.8%	2	1.5%	93	71.5%	34	26.2%	130	100.0%

Appendix Table 4. R&D expenditure in manufacturing sub-sectors measured in billion US dollars (PPP at current prices) and sectoral share per country, total 2009-2011.

	Chem.,Rubber,Plastics, Fuel & Non-met.Min.		Electronics,Electrical Eq.,Machinery & Motorv.		Food,Beverages & Tobacco		Furniture,Repair and Install. & Other		Metals		Paper,Wood & Printing		Textiles		Total	
Australia	2.06	22.5%	3.51	38.4%	1.10	12.1%	0.55	6.0%	1.45	15.8%	0.39	4.3%	0.09	0.9%	9.15	100.0%
Austria	2.12	16.7%	8.71	68.5%	0.11	0.9%	0.54	4.2%	0.96	7.5%	0.20	1.6%	0.07	0.6%	12.71	100.0%
Belgium	6.01	53.7%	3.73	33.4%	0.39	3.5%	0.12	1.0%	0.69	6.2%	0.06	0.6%	0.18	1.6%	11.18	100.0%
Canada	3.75	20.1%	11.65	62.4%	0.46	2.5%	0.59	3.1%	1.34	7.2%	0.68	3.7%	0.19	1.0%	18.66	100.0%
China	75.96	18.5%	236.44	57.6%	17.34	4.2%	3.47	0.8%	58.07	14.2%	6.41	1.6%	12.52	3.1%	410.20	100.0%
Czech Republic	0.68	17.7%	2.27	59.3%	0.07	1.8%	0.52	13.7%	0.21	5.5%	0.01	0.3%	0.07	1.8%	3.84	100.0%
Denmark	3.43	47.8%	3.10	43.1%	0.17	2.4%	0.39	5.5%	0.06	0.8%	0.02	0.3%	0.01	0.1%	7.18	100.0%
Finland	1.11	8.6%	10.69	83.5%	0.20	1.6%	0.10	0.8%	0.34	2.6%	0.33	2.6%	0.04	0.3%	12.81	100.0%
France	9.80	19.8%	33.05	66.8%	1.20	2.4%	1.78	3.6%	2.98	6.0%	0.22	0.5%	0.46	0.9%	49.49	100.0%
Germany	31.49	20.4%	111.54	72.4%	1.20	0.8%	4.14	2.7%	4.59	3.0%	0.71	0.5%	0.46	0.3%	154.14	100.0%
Italy	4.75	16.3%	19.83	67.9%	0.61	2.1%	0.78	2.7%	1.40	4.8%	0.28	1.0%	1.58	5.4%	29.23	100.0%
Japan	65.98	23.2%	192.81	67.8%	6.31	2.2%	5.73	2.0%	7.99	2.8%	2.24	0.8%	3.44	1.2%	284.48	100.0%
Korea	12.60	12.3%	83.70	81.4%	1.28	1.2%	0.89	0.9%	3.34	3.2%	0.26	0.3%	0.73	0.7%	102.81	100.0%
Norway	0.62	22.0%	1.22	43.3%	0.29	10.2%	0.16	5.6%	0.39	13.8%	0.11	4.0%	0.03	1.2%	2.83	100.0%
Poland	0.59	23.4%	1.26	49.8%	0.19	7.4%	0.18	7.0%	0.24	9.5%	0.05	1.9%	0.02	0.9%	2.53	100.0%
Portugal	0.74	36.7%	0.58	28.8%	0.21	10.6%	0.07	3.3%	0.19	9.3%	0.13	6.4%	0.10	4.8%	2.02	100.0%
Slovenia	0.88	45.4%	0.79	41.1%	0.01	0.6%	0.05	2.7%	0.14	7.3%	0.03	1.3%	0.03	1.6%	1.93	100.0%
Spain	5.45	31.6%	8.67	50.3%	0.95	5.5%	0.44	2.5%	1.09	6.3%	0.23	1.3%	0.41	2.4%	17.24	100.0%
Sweden	3.05	15.6%	14.19	72.3%	0.13	0.7%	0.58	2.9%	0.96	4.9%	0.71	3.6%	0.02	0.1%	19.64	100.0%
Turkey	1.24	17.8%	4.58	65.7%	0.22	3.2%	0.17	2.4%	0.49	7.0%	0.03	0.5%	0.23	3.4%	6.96	100.0%
United Kingdom	4.02	14.9%	17.53	64.9%	1.13	4.2%	1.31	4.8%	2.87	10.6%	0.07	0.3%	0.07	0.3%	26.99	100.0%
United States	180.36	30.4%	355.20	59.9%	14.30	2.4%	28.63	4.8%	7.74	1.3%	5.44	0.9%	1.55	0.3%	593.21	100.0%
Total	416.67	23.4%	1125.06	63.2%	47.90	2.7%	51.18	2.9%	97.51	5.5%	18.62	1.0%	22.30	1.3%	1779.23	100.0%

Source: Own elaboration based on OECD ANBERD database.

Tables corresponding to Figures 1 to 4.

Figure 1. Number of inward FDI greenfield projects, global and by country category, 2003-2011.

	2003	2004	2005	2006	2007	2008	2009	2010	2011
EIEs	3580	4207	3930	5081	4546	6123	4777	4959	5417
IEs	5023	5446	5914	6776	7341	9189	8052	8376	8336
LDCs	104	69	114	130	106	300	240	263	308
ODEs	825	740	900	868	1048	1647	1405	1203	1266

Figure 2. Number of outward FDI greenfield projects, global and by country category, 2003-2011.

	2003	2004	2005	2006	2007	2008	2009	2010	2011
EIEs	767	751	701	971	1018	1412	1203	1469	1569
IEs	8639	9614	10044	11739	11868	15551	12981	13058	13527
LDCs	4	1	6	8	10	34	34	22	29
ODEs	122	96	107	137	145	262	256	252	202

Figure 3. Inward greenfield FDI investments in manufacturing per country category, 2003 -2011.

	2003	2004	2005	2006	2007	2008	2009	2010	2011
EIEs	1939	2258	1977	2361	2146	2811	2186	2548	2778
IEs	2443	2520	2651	2931	3019	3614	3118	3564	3477
LDCs	38	24	41	48	31	91	66	87	108
ODEs	334	289	347	295	410	562	453	395	461

Figure 4. Inward FDI greenfield investments in services per country category, 2003 -2011.

	2003	2004	2005	2006	2007	2008	2009	2010	2011
EIEs	1337	1705	1670	2378	2054	2714	2170	2130	2285
IEs	2345	2739	2985	3524	3922	4865	4398	4426	4466
LDCs	28	24	34	55	50	141	140	137	159
ODEs	320	334	378	462	499	820	707	688	699

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